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(54) **PORTABLE MEDICAL PANORAMIC RADIOGRAPHIC DEVICE**

TRAGBARES, MEDIZINISCHES PANORAMA-RÖNTGENGERÄT

DISPOSITIF MEDICAL RADIOGRAPHIQUE, PANORAMIQUE ET PORTABLE

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EP 0 734 641 B1

Description

[0001] This invention relates to a mobile radiographic unit, and more particularly to a mobile, light-weight, panoramic radiographic unit on which X-rays of a patient may be taken while the patient is in a reclining position or in any non-upright and non-vertical position.

[0002] X-ray machines for medical use are commonplace. Perhaps the most familiar of these are those found in a dentist's office. When X-rays are taken with these devices, a patient is typically seated in a specially designed chair, which, although itself adjustable, is fixed to the floor. X-ray film is placed in a carrier, and the carrier and film are placed in the patient's mouth adjacent to the dental area to be radiologically imaged. An X-ray unit on a hinged, or possibly gooseneck-like support, is then placed into the proper position and energized by the dentist or an assistant, exposing the film in the mouth of the patient. This process is typically repeated several times, at least once for each dental region for which an image is required. Panoramic views of the mouth are either highly impractical or impossible with such X-ray devices. Moreover, the chair and X-ray unit are not portable; the patient must come to the dentist's office and be seated in a particular location to have X-rays taken this way.

[0003] US-A-3617742 discloses the obtention of a panoramic radiograph of the upper and lower dental arches composed from over-lapping exposures of X-rays directed successively at different angles from the back of the patient's head towards a forwardly disposed extra-oral film supported on a vertically adjustable framework.

[0004] Most other medical X-rays, such as those in physician's offices and hospitals are also taken with devices that are non-portable. Generally, a patient must either go under his own power to a place where the X-ray can be taken, or he must be carried there. Even if the patient is carried to the X-ray machine because he is otherwise non-ambulatory, he must usually be removed from a wheelchair, cot or gumey on which he was carried and placed on a special support in an upright/vertical position to have his Xray taken.

[0005] It would thus be desirable from a medical standpoint to have a portable X-ray unit that did not require a patient to be removed from his surgical bed, gumey, table or stretcher. Moreover, it would be very desirable to have an X-ray machine that was capable of producing a panoramic X-ray view, for dental and other purposes.

[0006] Portable X-ray units are known to the art, as are mobile stands. One such mobile stand currently marketed comprises a number components that can be assembled and disassembled readily. In this design, a number of telescoping tubes can be fit together, and the assembled tubes are vertically positioned in a base having four legs and casters to provide a vertical support column. One end of the arm is adapted to hold an X-ray unit, while the other end is adapted to clamp onto the vertical support column at a selected height. The arm holds the X-ray unit at an elevated position horizontally distant from the vertical support column. The X-ray unit may have substantial weight. Since it is held horizontally distant from the vertical support column, the base is designed to accommodate the horizontally-shifted center of gravity, and thus provide a stable support. However, no support is provided for a reclining patient. Also, no means is provided for taking a panoramic X-ray view from such a portable X-ray unit in conjunction with a mobile stand and no means is provided for taking a panoramic x-ray from any position other than the patient being in an upright/vertical position.

[0007] According to the present invention there is provided a portable medical radiographic device for a radiological source and radiologically sensitive film, comprising:

a. a mobile base;
b. an elongate supporting structure attached to the mobile base, the supporting structure comprising a plurality of sections and adjustable joints interconnecting the sections;
c. means for mounting the radiological source at a selected position on a first one of the plurality of sections, the means for mounting comprising an elongated arcuate track for movably mounting the radiological source on a concave portion thereof, so that rays from the radiological source are directed away from the concave portion of the track;
d. means for supporting the radiologically sensitive film at a selected position on a second one of the plurality of sections, the means for supporting comprising an elongated arcuate cylinder for supporting a film cartridge containing the radiologically sensitive film in a concave portion thereof, so that the radiologically sensitive film is exposed by radiation directed towards the concave portion of the cylinder, and
e. energizable source transport means for moving the radiological source along the length of the elongated track; the track and cylinder having adjustable orientations and the first and second ones of the plurality of sections being selected to permit the respective concave portions of the track and the cylinder to be positioned in opposition to one another so that, when a selected portion of a body is interposed between the source mounting means and the film support means, and the radiological source and the source transport means are simultaneously energized, the moving radiological source exposes an elongate strip of radiologically sensitive film through the selected portion of the body, thereby creating a panoramic radiological image of the selected portion of the body.

[0008] The device may further comprise an energiza-

ble film advancement means to transport the radiological film along the length of the cylinder to spread out the radiological image of the selected portion of the body.

[0009] The supporting structure may further comprise a third section having an adjustable length, the third section being located between the first and second sections so that the distance between the track and the cylinder is adjustable.

[0010] The third section comprises at least a pair of tubes in slidable engagement with one another. Alternatively the third section may comprise a first locking means for locking the pair of tubes in a selected fixed position. One of the joints may be a fully-adjustable positioning joint or a rotatable hinge joint.

[0011] At least a pair of the plurality of sections of the supporting structure and the one of the adjustable joints interconnecting the pair of sections are adapted to permit electrical wiring to run continuously therethrough.

[0012] Preferably, the source transport means comprises a servo motor and the film advancement means comprises at least a second servo motor.

[0013] The device may further comprise alignment indicator means for indicating alignment of the track and cylinder and an orientation adjustment means slidably engaged with the track for adjusting the orientation of the track within a selected plane.

[0014] If the selected portion of the body is the head, and the body is in a reclining position, the device may further comprise head positioning means to support the head between the source positioning means and the film support means.

[0015] According to the present invention there may be further provided a radiologic film scanning device, the film scanning device comprising:

a. an elongated housing having a top side, a bottom side, a front side, a back side, a first end and a second end;

b. a first roller disposed within the housing near the first end, the vertical axis of the roller being substantially perpendicular to the bottom of the housing;

c. a second roller disposed within the housing near the second end, the vertical axis of the roller being substantially perpendicular to the bottom of the housing;

d. means for supporting a radiologic film sheet within the enclosure so that the film sheet is substantially parallel with the front side and is disposed between the first roller and the second roller; and

e. a masking ribbon that is radiopaque, having an elongated aperture transparent to x-rays passing therethrough, the aperture being perpendicular to the length of the ribbon, the ribbon disposed within the housing parallel to the film sheet and configured in a loop around the first roller, the second rotter and the film sheet, so that as the rollers rotate on their axes, the aperture will move in the direction of rotation of the rollers and so that when the housing is exposed to x-rays, the x-rays will pass through the aperture and expose the portion of the film sheet underlying the aperture as the aperture moves from the first roller to the second roller and the radiopaque portion will prevent those portions of the film sheet not underlying the aperture from being exposed to the x-rays.

[0016] Preferably, the cylinder is fixedly attached to the second one of the plurality of sections and offset therefrom so that, in a plane perpendicular to a longitudinal axis of the second one of the plurality of sections, a first line joining the intersection of the plane with a first point on the cylinder half-way between the longitudinal ends of the cylinder and the intersection of the plane with the longitudinal axis is not perpendicular to a second line tangent to the support at the first point.

[0017] Preferably, a sprocket is disposed at an end of one of the rollers and wherein the masking ribbon has a plurality of evenly spaced apart holes along an edge of the ribbon passing therethrough, the holes being engagable with the sprocket. so that as the roller rotates, the sprocket engages the holes thereby causing the aperture to move a predetermined distance for each rotation of the roller.

[0018] The front side of the housing may be substantially arcuate and the means for supporting a radiologic film sheet within the enclosure is substantially arcuate.

[0019] The device may further comprise means for guiding the masking ribbon, disposed within the enclosure, so that the aperture is held at a predetermined distance from the portion of the film sheet being exposed as the aperture moves from the first roller to the second roller.

[0020] The radiopaque portion may comprise a metal dense enough to block the passage of x-rays. This may be made from aluminium, copper, lead or an alloy.

[0021] The present invention will now be described in more detail with reference to the accompanying drawings in which:

FIG. 1 is a perspective view of a portable panoramic radiographic device in accordance with the invention.

FIG. 2 shows a simple alignment device to line up the film with the radiographic source for proper positioning.

FIG. 3(a) is a top view of the mounting means for the radiographic source and for the film.

FIG. 3(b) is a top schematic view of the direction of movement of the film and the radiographic source in Fig. 3(a).

FIG. 4 is a schematic view of a film cylinder of a preferred embodiment conjunction with an oppos-

ing radiographic source.

FIG. 5 is a top view of a film cartridge suitable for use in the film cylinder of embodiment of Fig. 4.

FIG. 6 is a perspective view of the portable panoramic radiographic device in use.

FIG. 7 is a perspective view of a head positioner in accordance with the invention suitable for use with the portable panoramic radiographic device of Fig. 1.

FIG. 8 is a top view of an alternate embodiment of a film cartridge arm suitable for use for radiographic imaging of an elbow or joint.

FIG. 9(a) is a top front perspective view of a scanning device in accordance with the present invention with the housing depicted in broken lines.

FIG. 9(b) is a front elevational view of a scanning device of FIG. 9a.

FIG. 9(c) is a top plan view of the scanning device of FIG. 9a.

FIG. 10 is a front perspective view of the masking ribbon used in the scanning device of FIG. 9.

FIG. 11 is a perspective view of a roller used in the scanning device of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] A preferred embodiment of the invention is illustrated in Fig. 1. In this embodiment, which is primarily designed for dental use, the portable radiographic imaging device **8** comprises a base **10,** which includes a number of legs **12,12'** radiating as spokes from a hub **13**. Casters **14** are provided at the ends of legs **12** and **12'** to allow convenient movement of the portable radiographic imaging device **8**. As will be further described below, the portion of the portable radiographic imaging device **8** above base **10** has a center of gravity that will not, in general, coincide with hub **13**. Therefore, one pair of adjacent legs **12** is larger than the other pair of adjacent legs **12'** in the preferred embodiment. It will, of course, be readily appreciated that the details of the base **10** are not critical to the invention; alternate base designs that provide mobility and stability for an off center and possibly shifting center of gravity can be used.

[0023] An elongated, articulated supporting structure **15** having a first support column section **16** is attached at a first end in a conventional manner to the base **10** and rises generally perpendicularly from it. Column section **16** may be made of metal (preferably, a light weight metal) or any other suitable material. Mounted on column section **16** at a convenient height for the operator of the apparatus is control apparatus **18** for the radiographic source **30** (which is commonly called a "camera," even though the film collecting the image is external to the device), film feed motor **50**, and camera tracking motors **60**, which are mounted on section **22**, as noted below. Although it is not required to be, column section **16** is preferably hollow, which serves not only to reduce its weight, but also to allow wires (not shown) from control apparatus **18** to the electrical components of the imaging device **8** to be run therethrough. Alternately, the wires from control apparatus **18** may simply be run along the outside of the column sections **16**,**22**.

[0024] The second end of first support column section **16** joins with the first end of the second support column section **22** by means of a first joint **20**. Joint **20** may preferably be a conventional fully-adjustable positioning joint, or it may simply be a conventional rotatable hinge. Other alternatives are possible, provided that the angle at which second support column section **22** joins first support column section **16** is adjustable. It is also desirable that joint **20** be provided with a positive locking mechanism to prevent slippage once it is appropriately adjusted rather than to rely solely on friction. As with section **16**, column section **22** is preferably hollow to reduce the weight of the device and to permit the wires (not shown) to be run therethrough. Certain types of joints **20** also permit wires to run therethrough, for example, hinged joints, and may be used to avoid the necessity of having relatively unprotected wires nmning along the outside of the device.

[0025] Attached to second column section **22** is an adjustable hook **24**, which is slidably attached along the length of second column section **22**, and which preferably is provided with conventional means to lock the hook **24** at a selectable position along the length of second column section **22**. An arcuate or C-shaped motorized track **26** is provided which is attached to hook **24**. One or more motors **60** are provided to move a radiological source (camera) **28** along track **26**. Power and control for the motors **60** and camera **28** are provided via the power and control wires (not shown) connected to control apparatus **18**. Hook **24** may include position adjustments similar to those of a conventional camera tripod base to permit adjustment of the plane in which track **26** is positioned. In addition, track **26** is preferably slidably engaged with hook **24** to allow adjustment of the orientation of track **26** within a selected plane. Track **26** is preferably provided with end pieces **30** to prevent the track from being accidently removed from hook **24** during adjustment and to provide positive stops at the ends of travel of camera **28.**

[0026] The second end of second column section **22** is attached to a second joint **32,** which may be of similar construction to first joint **20**. Also attached to second joint **32** is an extension sleeve **34,** which slidably engages therein one end of a third column section **38**. The slidable engagement of sleeve **34** and column section

38 forms an adjustable length section, allowing the distance between motorized track **26** and film cylinder **48** to be adjusted to better accommodate a portion of a patient's body therebetween. In a preferred embodiment, a tightening nut **36** is provided to lock the third column section **38** in a fixed position within the extension sleeve **34**. It will, of course, be understood that other telescoping arrangements may be used, and other locking arrangements are possible.

[0027] The other end of third column section **38** is attached to a first end of a fourth column section **42** by means of a third joint **40**, which is of a construction similar to joints **32** and **20.** The second end of fourth column section **42** is provided, in the preferred embodiment, with a pivot **44,** which allows rotation of a leg **46** in one plane. If additional movements are required, however, pivot **44** may be replaced with another type of joint. Leg **46** is attached to the center of a film cylinder **48**, into which a film cartridge (not shown in Fig. 1) is placed. Arcuate or C-shaped film cylinder **48** is preferably constructed out of a hollow piece of polymer or a light-weight metal in a manner to be described below. A motor **50** is preferably provided for advancing film in the film cartridge. The motor **50** is powered and controlled by additional power and control wires (not shown) from control apparatus **18**, which may preferably be run inside hollow column sections **16**, **22, 38**, and **42**, or alternately, alongside them. Only the back of film cylinder **48** (i.e., the convex side) need be opaque, since X-rays or other radiation from camera **28** will go through the film, which is supported by the concave side of film cylinder **48**, the exception being if synchronized, moveable opaque surfaces at certain times need be incorporated along the front of the film to prevent additional overexposure or scattering of the x-ray beam to the yet unexposed film along its path of movement.

[0028] Film cylinder **48** may be provided with slip-on radiolucent sleeves (not shown) to aid in holding or guiding a film cartridge.

[0029] To ensure that, in use, the camera track **26** is positioned so that the camera will expose the entire length of a film cartridge supported in film cylinder **48** and that the beam from the camera will be perpendicular thereto, the ends of film cylinder **48** may be provided with retractable markers **56**, as shown in Fig. 2. Marker **56**, which is similar to a lanyard, a plumb line, or perhaps a coiled telephone cord, is manually drawn from an attachment point **54** on the film cylinder **48** to an index mark **58** on a camera stop **30** to permit simple visual alignment. Similar alignment markers **56** may be employed at each end of the film cylinder **48** to ensure adequate alignment. Other alignment devices and methods may be used, but the device and method described here has the advantage of being simple and very inexpensive.

[0030] Turning now to Fig. 3(a), the tracking of the camera and the film can be readily understood. C-shaped motorized track **26**, on which camera **28** travels, is adjusted to permit the camera **28** to be aimed at an opposing section of film cylinder **48** over its entire length of travel along motorized track **26**. Adjustment of the apparatus is accomplished by the manipulation of joints **20, 32, 40**, and hinge **44**, together with the sliding adjustment of motorized track **26** through hook **24** and tilting of hook **24,** which is preferably adjustable in several directions as is a camera tripod. One or more motors **60** are provided to move the motor by any conventional means (e.g., sprockets, belts or pulleys) across C-shaped motorized track **26**. Motors **60** are also conventional; servo or synchronous motors or any other type suitable for use with an automated camera **28** may be used. An additional motor **50** is for film cylinder **48**. (The motor **50** may be mounted in a convenient position along the film cylinder **48**.) Of course, the portion of the patient's body to be filmed is placed between the motorized track **26** and the film cylinder **48**, so that radiation from camera **28** will pass through the body and expose film in film cylinder **48**.

[0031] Motor **50** is optional, because film in film cylinder **48** need not be moved during exposure. However, some scattering of the radiation beam will usually occur during exposure, which may overexpose some portions of the film. In addition, it is usually desirable to have an expanded view of the area of the body (such as the teeth and mouth area for dental purposes) provided on the film. Motor **50** provides a solution to the scattering problem as well as providing the desired expanded panoramic view. As shown in Fig. 3(b), during exposure, motor **50** transports film **62** using conventional sprocket holes **64** through film cylinder **48** in the direction of arrow A. Meanwhile, motors **60** transport camera **28** simultaneously over track **26** in the direction shown by arrow B.

[0032] It will be readily appreciated that the relative motions of film **62** and camera **28** will spread out not only the image of the body area on the film **62**, but will also avoid the scattering problem by spreading out the scattered radiation. The relative speeds of film **62** and camera **28** may be adjusted to control the exposure and degree of image-spreading. It will also be appreciated that a film cartridge containing film **62** must be of greater length than film cylinder **48** if film **62** is moved as shown in Fig. 3(b) and the maximum panoramic view is required. Thus, for a maximum panoramic view, a film cartridge mounted into film cylinder **48** would extend beyond at least one end of film cylinder **48.** After exposure, the excess length of the film cartridge will be transferred to the other end of film cylinder **48**. The excess film will, at the beginning and end of the exposure, be at the end of the film cylinder **48** adjacent the initial and final positions, respectively, of the camera **28** on motorized track **26**.

[0033] Fig. 4 shows the relationship of the camera **28** to the film cylinder **48** as might be the case at the beginning of an exposure. Camera **28** projects a beam **68**, which travels through a portion of the patient's body (not shown) and onto a spot **66** of the film. Slip-on radiolucent

sleeves **52** at either end of film cylinder **48** may be used to guide the film over the film cylinder **48.** Other conventional film-guiding means may also be used. Sprockets (not shown) at each end coupled to motor **50** may be used to engage the film so that a spread-out panoramic view is obtained; other means for engaging the film, such as friction rollers, may also be used. A typical film cartridge is shown in Fig. 5, showing sprocket holes **64** for engaging the film **62** with the feeding mechanism of film cylinder **48**. The film **62** itself is protected from exposure by film cartridge or sleeve **68** in a manner familiar to those using X-ray films.

[0034] A typical use of the device **8** described above is shown in Fig. 6. Patient **70**, here shown reclining on a moveable table **74** having legs **76** with casters **78**, has his shoulders supported by a shoulder support **72**, described in greater detail below. As shown, patient **70** is positioned to provide a panoramic view of the patient's mouth.

[0035] Head positioner **72** is shown in greater detail in Fig. 7. A wedge portion **80** is provided for support under a patient's shoulders. A head support **84** is attached to wedge **80** by a suitable, adjustable extension **82**. The positioner **72** is designed to have a stable base with an edge at the shoulder, which is evident in wedge **80** as shown. The shoulders are slightly elevated, and the head rests in a position slightly above the shoulders.

[0036] As shown in Fig. 6, the radiographic imaging device **8** is suitable for dental imaging. However, it will be readily apparent that the portable radiographic imaging device 8 may also be used as a radiographic adjunct for OMFS, plastic surgery, ENT, trauma, orthopedic surgery, and other uses where a lightweight, portable imaging device is desirable. It is particularly suitable for non-ambulatory patients, and may be advantageously used in OR (e.g., prior to or post-surgical uses, or swelling/bandaging), in the recovery room, in nursing homes, and in trauma centers.

[0037] An alternate embodiment shown in Fig. 8 provides for additional uses of imaging device **8**. Here, in a plane perpendicular to the axis of support column **42**, film cylinder **48** is fixedly mounted by a mounting means **88** so that the center of the concave portion of the C-shaped cylinder **48** is offset somewhat from the axis of support column **42,** such that a line drawn from the axis to the center of the concave portion of C-shaped cylinder **48** in this plane is not perpendicular to a tangent to C-shaped cylinder **48** drawn from this center point. This mounting is more suitable for orthopedic panoramic views of knees, ankles, and elbows, as well as radiolucent cervical collars.

[0038] Referring to FIGS. 9-11, the preferred embodiment of the radiologic film scanning device is now described in detail.

[0039] As shown in FIG. 9a - FIG. 9c, the film scanning device **100** comprises elongated housing **110** with a means for supporting a radiologic film sheet **112** therein. The housing can be made of any suitable material obvious to one skilled in the art.

[0040] Disposed within the housing **110** are two rollers **120** on either side of the film sheet **112**. A masking ribbon **130** is configured in a loop around the two rollers **120** so that as the rollers **120** rotate, the masking ribbon **130** travels in the direction of rotation. At least the portion of the masking ribbon **130** that overlies the film sheet **112** is radiopaque, which means that it is opaque to the wavelengths of electromagnetic radiation to which the film sheet **112** is sensitive. The masking ribbon **130** can be made of any metal dense enough to Mock the passage of x-rays. Such metals include: aluminum, copper, and lead. The material used in the masking ribbon must also be flexible enough to pass around the rollers **120** many times without loosing its masking qualities. The metal used would depend on the specific design and would be obvious to one skilled in the art.

[0041] The masking ribbon **130** has an elongated aperture **132** passing therethrough. The aperture **132** is transparent to the wavelengths of electromagnetic radiation to which the film sheet **112** is sensitive and is perpendicular to the masking ribbon **130**. The elongated dimension of the aperture **132** must be as long as the width of the portion of the film sheet **112** which will be exposed to x-rays. The narrower dimension of the aperture is determined by the required level of exposure of the film sheet **112** and the rate at which the aperture **132** passes over the film sheet **112**. Typically the elongated dimension could be 13.5 cm and the narrower dimension could be 1.25 cm, although other dimensions could be used depending upon the requirements of the specific application.

[0042] A guide means **134** for guiding the masking ribbon **130** in a arcuate path is disposed within the enclosure. The guide means could take the form of a track, a plurality of rollers or any means to make the masking ribbon **130** follow an arcuate path in front of the film sheet **112**.

[0043] As shown in FIG. 10, the masking ribbon **130** may have a plurality of evenly spaced-apart holes **142** passing through one edge. The holes **142** are engagable in the teeth of a sprocket **140** which is integrated onto one end of one of the rollers **120** (as shown in FIG. 11). When the sprocket **140** rotates with its associated roller **120**, the masking ribbon **130** is moved a fixed distance for each revolution of the sprocket **140** as it engages the holes **142**. In an alternative embodiment, as shown in FIG. 10, the masking ribbon has sprocket holes **142** along both edges. This embodiment would allow the use of a roller with sprockets at both ends.

[0044] The above embodiments are given as illustrative examples and are not intended to impose any limitations on the invention. It will be readily appreciated that many deviations may be made from the specific embodiments disclosed in this specification without departing from the invention. Accordingly it is intended to cover all such modifications as within the scope of this invention.

Claims

1. A portable medical radiographic device (8) for a radiological source (28) and radiologically sensitive film, comprising:

   a. a mobile base (10);
   b. an elongate supporting structure (15) attached to the mobile base (10), the supporting structure (15) comprising a plurality of sections and adjustable joints interconnecting the sections;
   c. means (88) for mounting the radiological source (28) at a selected position on a first one of the plurality of sections, the means (88) for mounting comprising an elongated arcuate track (20) for movably mounting the radiological source (28) on a concave portion thereof, so that rays from the radiological source (28) are directed away from the concave portion of the track (26);
   d. means (48) for supporting the radiologically sensitive film (62) at a selected position on a second one of the plurality of sections, the means (48) for supporting comprising an elongated arcuate cylinder (48) for supporting a film cartridge (68) containing the radiologically sensitive film (62) in a concave portion thereof, so that the radiologically sensitive film (62) is exposed by radiation directed towards the concave portion of the cylinder (48); and
   e. energizable source transport means comprising a motor (60) for moving the radiological source (28) along the length of the elongated track (26); the track (26) and cylinder (48) having adjustable orientations and the first and second ones of the plurality of sections being selected to permit the respective concave portions of the track (26) and the cylinder (48) to be positioned in opposition to one another so that, when a selected portion of a body is interposed between the source mounting means (88) and the film support means (48), and the radiological source (28) and the source transport means comprising a motor (60) are simultaneously energized, the moving radiological source (28) exposes an elongate strip of radiologically sensitive film (62) through the selected portion of the body, thereby creating a panoramic radiological image of the selected portion of the body.

2. The device (8) of Claim 1, further comprising energizable film advancement means to transport the radiological film (62) along the length of the cylinder (48) to spread out the radiological image of the selected portion of the body.

3. The device (8) of Claim 2, wherein the supporting structure further comprises a third section (38) having an adjustable length, the third section (38) being located between the first and second sections so that the distance between the track (26) and the cylinder (48) is adjustable.

4. The device (8) of Claim 3, wherein the third section (38) comprises at least a pair of tubes in slidable engagement with one another.

5. The device (8) of Claim 4, wherein the third section (38) comprises a first locking means for locking the pair of tubes in a selected fixed position.

6. The device (8) of Claim 1, wherein at least one of the joints is a fully-adjustable positioning joint (20).

7. The device (8) of Claim 1, wherein at least one of the joints is a rotatable hinge.

8. The device (8) of Claim 1, wherein at least one of the plurality of sections of the supporting structure is adapted to permit electrical wiring to run therethrough.

9. The device (8) of Claim 1, wherein at least a pair of the plurality of sections of the supporting structure and the one of the adjustable joints interconnecting the pair of sections are adapted to permit electrical wiring to run continuously therethrough.

10. The device (8) of Claim 1, wherein the source transport means comprises a servo motor.

11. The device (8) of Claim 2, wherein the source transport means comprises at least a first servo motor, and the film advancement means comprises at least a second servo motor.

12. The device (8) of Claim 1, further comprising alignment indicator means for indicating alignment of the track (26) and cylinder (48).

13. The device (8) of Claim 1, further comprising an orientation adjustment means slidably engaged with the track (26) for adjusting the orientation of the track (26) within a selected plane.

14. The device (8) of Claim 1, wherein the selected portion of the body is the head, and the body is in a reclining position, and further comprising head positioning means to support the head between the source positioning means and the film support means (48).

15. The device (8) of Claim 1, further comprising radiologic film scanning device (100), the film scanning

device (100) comprising:

a. an elongate housing (110) having a top side, a bottom side, a front side, a back side, a first end and a second end;
b. a first roller (120) disposed within the housing (110) near the first end, the vertical axis of the roller (120) being substantially perpendicular to the bottom of the housing (110);
c. a second roller (120) disposed within the housing (110) near the second end, the vertical axis of the roller (120) being substantially perpendicular to the bottom of the housing (110);
d. means (134) for supporting a radiologic film sheet (112) within the enclosure so that the film sheet (112) is substantially parallel with the front side and is disposed between the first roller (120) and the second roller (120); and
e. a masking ribbon (130) that is radiopaque, having an elongated aperture (132) transparent to x-rays passing therethrough, the aperture (132) being perpendicular to the length of the ribbon (130), the ribbon (130) disposed within the housing (110) parallel to the film sheet (112) and configured in a loop around the first roller (120), the second roller (120) and the film sheet (112), so that as the rollers (120) rotate on their axes, the aperture (132) will move in the direction of rotation of the rollers (120) and so that when the housing (110) is exposed to x-rays, the x-rays will pass through the aperture (132) and expose the portion of the film sheet (112) underlying the aperture (132) as the aperture (132) moves from the first roller (120) to the second roller (120) and the radio-opaque portion will prevent those portions of the film sheet (112) not underlying the aperture (132) from being exposed to the x-rays.

16. A device (8) of claim 1, wherein the cylinder (48) is fixedly attached to the second one of the plurality of sections and offset therefrom so that, in a plane perpendicular to a longitudinal axis of the second one of the plurality of sections, a first line joining the intersection of the plane with a first point on the cylinder (48) half-way between the longitudinal ends of the cylinder (48) and the intersection of the plane with the longitudinal axis is not perpendicular to a second line tangent to the support at the first point.

17. The film scanning device (100) of Claim 15, wherein a sprocket (140) is disposed at an end of one of the rollers (120) and wherein the masking ribbon (130) has a plurality of evenly spaced apart holes (142) along an edge of the ribbon (130) passing therethrough, the holes (142) being engagable with the sprocket (140) so that as the roller rotates, the sprocket (140) engages the holes (142) thereby causing the aperture (132) to move a predetermined distance for each rotation of the roller (120).

18. The film scanning device (100) of Claim 15, wherein the front side of the housing (110) is substantially arcuate and the means for supporting a radiologic film sheet (112) within the enclosure is substantially arcuate.

19. The film scanning device (100) of Claim 15, further comprising means for guiding the masking ribbon (130), disposed within the enclosure, so that the aperture (132) is held at a predetermined distance from the portion of the film sheet (112) being exposed as the aperture (132) moves from the first roller (120) to the second roller (120).

20. The film scanning device (100) of Claim 15, wherein the radiopaque portion (130) comprises a metal dense enough to block the passage of x-rays.

21. The film scanning device (100) of Claim 20, wherein the metal is aluminum.

22. The film scanning device (100) of Claim 20, wherein the metal is copper.

23. The film scanning device (100) of Claim 20, wherein the metal is lead.

24. The film scanning device (100) of Claim 20, wherein the metal is an alloy.

Patentansprüche

1. Tragbares medizinisches Röntgengerät (8) für eine Röntgenquelle (28) und einen gegenüber Röntgenstrahlen empfindlichen Film, umfassend:

a. ein mobiles Untergestell (10);
b. eine längliche Tragstruktur (15), die an dem mobilen Untergestell (10) angebracht ist, wobei die Tragstruktur (15) mehrere Abschnitte umfaßt, sowie einstellbare Gelenke, welche die Abschnitte miteinander verbinden;
c. Mittel (88) zum Montieren der Röntgenquelle (28) bei einer ausgewählten Stelle an einem ersten der mehreren Abschnitte, wobei die Mittel (88) zum Montieren eine längliche, gekrümmte Bahn (20) umfassen zum beweglichen Montieren der Röntgenquelle (28) an einem konkaven Abschnitt von ihr, so daß Strahlen von der Röntgenquelle (28) von dem konkaven Abschnitt der Bahn (26) weg gerichtet sind;
d. Mittel (48) zum Tragen des gegenüber Röntgenstrahlen empfindlichen Films (62) bei einer ausgewählten Stelle an einem zweiten der

mehreren Abschnitte, wobei die Mittel (48) zum Tragen einen länglichen, gekrümmten Zylinder (48) umfassen zum Tragen einer Filmkassette (68), die in einem konkaven Abschnitt von ihr den gegenüber Röntgenstrahlen empfindlichen Film (62) beinhaltet, so daß der gegenüber Röntgenstrahlen empfindliche Film (62) belichtet wird durch Strahlung, die gerichtet ist in Richtung des konkaven Abschnitts des Zylinders (48); und

e. Transportmittel für eine anregbare Quelle umfassend einen Motor (60) zum Bewegen der Röntgenquelle (28) entlang der Länge der länglichen Bahn (26); wobei die Bahn (26) und der Zylinder (48) einstellbare Orientierungen haben und der erste sowie der zweite der mehreren Abschnitte so gewählt sind, daß sie es den entsprechenden konkaven Abschnitten der Bahn (26) und des Zylinders (48) gestatten, einander gegenüber positioniert zu sein, derart, daß wenn ein ausgewählter Abschnitt eines Körpers angeordnet ist zwischen dem Quellenmontagemittel (88) und dem Filmtragmittel (48) und die Röntgenquelle (28) und das einen Motor (60) umfassende Quellentransportmittel gleichzeitig angeregt werden, die sich bewegende Röntgenquelle (28) einen länglichen Streifen gegenüber Röntgenstrahlung empfindlichen Films (62) durch den ausgewählten Abschnitt des Körpers bestrahlt und dabei ein Panoramaröntgenbild des ausgewählten Abschnitts des Körpers erzeugt.

2. Gerät (8) nach Anspruch 1, des weiteren mit anregbaren Filmvorwärtsbewegungsmitteln zum Transportieren des gegenüber Röntgenstrahlen empfindlichen Films (62) entlang der Länge des Zylinders (48), um das Röntgenstrahlenbild des ausgewählten Abschnitts des Körpers aufzuweiten.

3. Gerät (8) nach Anspruch 2, bei dem die Tragstruktur des weiteren einen dritten Abschnitt (38) mit einstellbarer Länge umfaßt, wobei der dritte Abschnitt (38) zwischen dem ersten und dem zweiten Abschnitt derart angeordnet ist, daß der Abstand zwischen der Bahn (26) und dem Zylinder (48) einstellbar ist.

4. Gerät (8) nach Anspruch 3, bei welchem der dritte Abschnitt (38) wenigstens ein Paar in verschiebbarem Eingriff miteinander stehende Rohre umfaßt.

5. Gerät (8) nach Anspruch 4, bei welchem der dritte Abschnitt (38) ein erstes Verriegelungsmittel umfaßt zum Sperren des Paares an Rohren in einer ausgewählten, fixierten Stellung.

6. Gerät (8) nach Anspruch 1, bei welchem wenigstens eines der Gelenke ein volleinstellbares Positioniergelenk (20) ist.

7. Gerät (8) nach Anspruch 1, bei welchem wenigstens eines der Gelenke ein drehbares Scharnier ist.

8. Gerät (8) nach Anspruch 1, bei welchem wenigstens einer der mehreren Abschnitte der Tragstruktur ausgelegt ist, um durch ihn hindurch eine elektrische Verdrahtung verlaufen zu lassen.

9. Gerät (8) nach Anspruch 1, bei welchem wenigstens ein Paar der mehreren Abschnitte der Tragstruktur und das eine der einstellbaren Gelenke, das das Paar an Abschnitte miteinander verbindet, derart ausgelegt sind, um durch sie hindurch eine elektrische Verdrahtung verlaufen lassen.

10. Gerät (8) nach Anspruch 1, bei welchem das Quellentransportmittel einen Servomotor umfaßt.

11. Gerät (8) nach Anspruch 2, bei welchem das Quellentransportmittel wenigstens einen ersten Servomotor umfaßt und das Filmvorwärtsbewegmittel wenigstens einen zweiten Servomotor umfaßt.

12. Gerät (8) nach Anspruch 1, des weiteren umfassend Ausrichtanzeigemittel zum Anzeigen des Ausrichtens der Bahn (26) und des Zylinders (48).

13. Gerät nach Anspruch 1, des weiteren umfassend eine Orientierungseinstelleinrichtung, die verschiebbar in Eingriff steht mit der Bahn (26) zum Einstellen der Orientierung der Bahn (26) innerhalb einer ausgewählten Ebene.

14. Gerät (8) nach Anspruch 1, bei welchem der ausgewählte Abschnitt des Körpers der Kopf ist und der Körper in einer gestützten Stellung ist und des weiteren Kopfpositioniermittel umfassend zum Tragen des Kopfes zwischen den Quellenpositioniermitteln und dem Filmtragemittel (48).

15. Gerät (8) nach Anspruch 1, des weiteren eine Scanvorrichtung (100) für einen Röntgenfilm umfassend, wobei die Filmscanvorrichtung (100) umfaßt:

a. ein längliches Gehäuse (110) mit einer Oberseite, einer Unterseite, einer Vorderseite, einer Rückseite, einem ersten Ende und einem zweiten Ende;

b. eine erste Rolle (120), die innerhalb des Gehäuses (110) nahe dem erste Ende angeordnet ist, wobei die vertikale Achse der Rolle (120) im wesentlichen senkrecht zu dem Unteren des Gehäuses (110) ist;

c. eine zweite Rolle (120), die innerhalb des

Gehäuses (110) nahe dem zweiten Ende angeordnet ist, wobei die vertikale Achse der Rolle (120) im wesentlichen senkrecht zu dem Unteren des Gehäuses (110) ist;
d. Mittel (134) zum Tragen eines Röntgenfilmbogens (112) innerhalb der Einschließung, derart, daß der Filmbogen (112) im wesentlichen parallel zur Vorderseite und zwischen der ersten Rolle (120) und der zweiten Rolle (120) angeordnet ist; und
e. ein Maskierband (130), das röntgenstrahlenundurchlässig ist und eine längliche Öffnung (132) hat, die gegenüber durch sie gelangende Röntgenstrahlen transparent ist, wobei die Öffnung (132) senkrecht zu der Länge des Bandes (130) steht, das Band (130) innerhalb des Gehäuses (110), parallel zu dem Filmbogen (112) angeordnet und in einer Schleife um die erste Rolle (120), die zweite Rolle (120) und den Filmbogen (112) ausgeführt ist, so daß bei Drehung der Rollen (120) um ihre Achsen die Öffnung (132) sich in Richtung der Drehung der Rollen (120) bewegt und daß bei Aussetzen des Gehäuses (110) gegenüber Röntgenstrahlen, die Röntgenstrahlen durch die Öffnung (132) gelangen und den Abschnitt des Filmbogens (112) bestrahlen, der unter der Öffnung (132) liegt, wenn sich die Öffnung (132) von der ersten Rolle (120) zu der zweiten Rolle (120) bewegt und wobei der röntgenstrahlenundurchlässige Abschnitt diejenigen Abschnitte des Filmbogens (112), die nicht unter der Öffnung (132) liegen, davor schützt, von den Röntgenstrahlen bestrahlt zu werden.

16. Gerät (8) nach Anspruch 1, bei welchem der Zylinder (48) fest angebracht ist an dem zweiten der mehreren Abschnitte und derart dazu versetzt ist, daß in einer Ebene senkrecht zu einer Längsachse des zweiten der mehreren Abschnitte eine erste Linie, welche die Schnittstelle der Ebene mit einem ersten Punkt auf dem Zylinder (48) in der Hälfte zwischen den longitudinalen Enden des Zylinders (48) und der Schnittstelle der Ebene mit der Längsachse, nicht senkrecht ist zu einer zweiten Linie, die tangential zu dem Träger an dem ersten Punkt ist.

17. Filmscanvorrichtung (100) nach Anspruch 15, bei welcher ein Zahnrad (140) an einem Ende einer der Rollen (120) angeordnet ist und wobei das Maskierband (130) mehrere gleichmäßig voneinander beabstandete Löcher (142) entlang eines Randes des Bandes (130), durch dieses hindurchgelangend, hat, wobei die Löcher (142) in Eingriff bringbar sind mit dem Zahnrad (140), so daß bei Drehung der Rolle das Zahnrad (140) eingreift in die Löcher (142) und dabei bewirkt, daß die Öffnung (132) sich bei jeder Drehung der Rolle (120) um eine vorbestimmte Länge bewegt.

18. Filmscanvorrichtung (100) nach Anspruch 15, bei welcher die Vorderseite des Gehäuses (110) im wesentlichen gekrümmt ist und die Einrichtung zum Tragen eines Röntgenfilmbogens (112) innerhalb der Einschließung im wesentlichen gekrümmt ist.

19. Filmscanvorrichtung (100) nach Anspruch 15, des weiteren umfassend Mittel zum Führen des Maskierbandes (130), die innerhalb der Einschließung angeordnet sind, derart, daß die Öffnung (132) in einem vorbestimmten Abstand von dem Abschnitt des Filmbogens (112) gehalten ist, der bestrahlt wird, wenn sich die Öffnung (132) von der ersten Rolle (120) zu der zweiten Rolle (120) bewegt.

20. Filmscanvorrichtung (100) nach Anspruch 15, bei welcher der röntgenstrahlenundurchlässige Abschnitt (130) ein Metall umfaßt, das dicht genug ist, um den Durchgang von Röntgenstrahlen zu blokkieren.

21. Filmscanvorrichtung (100) nach Anspruch 20, bei welcher das Metall Aluminium ist.

22. Filmscanvorrichtung (100) nach Anspruch 20, bei welcher das Metall Kupfer ist.

23. Filmscanvorrichtung (100) nach Anspruch 20, bei welcher das Metall Blei ist.

24. Filmscanvorrichtung (100) nach Anspruch 20, bei welcher das Metall eine Legierung ist.

Revendications

1. Dispositif portable de radiographie médicale (8) pour une source radiologique (28) et un film radiosensible, comprenant:

a. une base mobile (10) ;
b. une structure support allongée (15) fixée à la base mobile (10), la structure support (15) comprenant plusieurs parties et des articulations réglables reliant les parties ;
c. un moyen (88) de montage de la source radiologique (28) à une position choisie sur une première de la pluralité de parties, le moyen de montage (88) comprenant une piste courbe allongée (20) pour monter de façon mobile la source radiologique (28) sur une partie concave de cette piste, de sorte que les rayons en provenance de la source radiologique (28) s'éloignent de la partie concave de la piste (26) ;
d. un moyen (48) de support du film radiosen-

sible (62) à une position choisie sur une seconde de la pluralité de parties, le moyen de support (48) comprenant un cylindre courbe allongé (48) pour porter une cartouche de film (68) contenant le film radiosensible (62) dans une partie concave de ce cylindre, de sorte que le film radiosensible (62) est exposé aux rayonnements dirigés vers la partie concave du cylindre (48) ; et

e. un moyen de transport de source alimentable comprenant un moteur (60) pour déplacer la source radiologique (28) sur la longueur de la piste allongée (26) ; la piste (26) et le cylindre (48) ayant des orientations réglables et les première et seconde de la pluralité de parties étant choisies pour permettre aux parties concaves respectives de la piste (26) et au cylindre (48) d'être disposés en face l'un de l'autre de sorte que, quand une partie choisie d'un corps est interposée entre le moyen de montage de source (88) et le moyen de support de film (48), et que la source radiologique (28) et le moyen de transport de source comprenant un moteur (60) sont alimentés simultanément, la source radiologique (28) se déplaçant expose une bande allongée du film radiosensible (62) vers la partie choisie du corps, créant ainsi une image radiologique panoramique de la partie choisie du corps.

2. Dispositif (8) selon la revendication 1, comprenant en outre un moyen alimentable d'avancement de film pour transporter le film radiosensible (62) sur la longueur du cylindre (48) pour étaler l'image radiologique de la partie choisie du corps.

3. Dispositif (8) selon la revendication 2, dans lequel la structure support comprend en outre une troisième partie (38) de longueur réglable, la troisième partie (38) étant située entre les première et deuxième parties de sorte que la distance entre la piste (26) et le cylindre (48) est réglable.

4. Dispositif (8) selon la revendication 3, dans lequel la troisième partie (38) comprend au moins deux tubes montés de façon à coulisser l'un par rapport à l'autre.

5. Dispositif (8) selon la revendication 4, dans lequel la troisième partie (38) comprend un premier moyen de verrouillage pour verrouiller les deux tubes à une position fixe choisie.

6. Dispositif (8) selon la revendication 1, dans lequel au moins une des articulations est une articulation de positionnement complètement réglable (20).

7. Dispositif (8) selon la revendication 1, dans lequel au moins une des articulations est une articulation rotative.

8. Dispositif (8) selon la revendication 1, dans lequel au moins une de la pluralité de parties de la structure support est adaptée à permettre à des liaisons électriques d'y passer.

9. Dispositif (8) selon la revendication 1, dans lequel au moins deux de la pluralité de parties de la structure support et celle des articulations réglables reliant les deux parties sont adaptées à permettre à une liaison électrique d'y passer de façon continue.

10. Dispositif (8) selon la revendication 1, dans lequel le moyen de transport de source comprend un servomoteur.

11. Dispositif (8) selon la revendication 2, dans lequel le moyen de transport de source comprend au moins un premier servomoteur et le moyen d'avancement de film comprend au moins un second servomoteur.

12. Dispositif (8) selon la revendication 1, comprenant en outre un moyen indicateur d'alignement pour indiquer l'alignement de la piste (26) et du cylindre (48).

13. Dispositif (8) selon la revendication 1, comprenant en outre un moyen de réglage d'orientation engagé à coulissement avec la piste (26) pour régler l'orientation de la piste (26) dans un plan choisi.

14. Dispositif (8) selon la revendication 1, dans lequel la partie choisie du corps est la tête et le corps est dans une position inclinée, comprenant en outre un moyen de positionnement de tête pour supporter la tête entre le moyen de positionnement de source et le moyen support de film (48).

15. Dispositif (8) selon la revendication 1, comprenant en outre un dispositif de balayage de film radiologique (100), le dispositif de balayage de film (100) comprenant :

a. un boîtier allongé (110) ayant un côté supérieur, un côté inférieur, un côté avant, un côté arrière, une première extrémité et une seconde extrémité ;

b. un premier rouleau (120) disposé dans le boîtier (110) près de la première extrémité, l'axe vertical du rouleau (120) étant sensiblement perpendiculaire au fond du boîtier (110) ;

c. un second rouleau (120) disposé dans le boîtier (110) près de la seconde extrémité, l'axe vertical du rouleau (120) étant sensiblement perpendiculaire au fond du boîtier (110) ;

d. un moyen (134) pour porter une feuille de film radiologique (112) dans l'enceinte de sorte que la feuille de film (112) est sensiblement parallèle au côté avant et est disposée entre le premier rouleau (120) et le second rouleau (120) ; et

e. un ruban de masquage (130) radio-opaque ayant une ouverture allongée (132) transparente aux rayons X passant au travers, l'ouverture (132) étant perpendiculaire à la longueur du ruban (130), le ruban (130) étant disposé dans le boîtier (110) parallèlement à la feuille de film (112) et étant conformé en une boucle autour du premier rouleau (120), du second rouleau (120) et de la feuille de film (112) de sorte que, quand les rouleaux (120) tournent sur leurs axes, l'ouverture (132) se déplace dans la direction de rotation des rouleaux (120) et de sorte que, quand le boîtier (110) est exposé aux rayons X, les rayons X passent par l'ouverture (132) et exposent la partie de la feuille de film (112) se trouvant sous l'ouverture (132) tandis que l'ouverture (132) se déplace du premier rouleau (120) au second rouleau (120) et la partie radio-opaque empêche les parties de la feuille de film (112) ne se trouvant pas sous l'ouverture (132) d'être exposées aux rayons X.

16. Dispositif (8) selon la revendication 1, dans lequel le cylindre (48) est fixé à la deuxième de la pluralité de parties et est décalé par rapport à celle-ci de sorte que, dans un plan perpendiculaire à l'axe longitudinal de la deuxième de la pluralité de parties, une première ligne reliant l'intersection du plan à un premier point sur le cylindre (48) à mi-chemin entre les extrémités longitudinales du cylindre (48), et l'intersection du plan avec l'axe longitudinal n'est pas perpendiculaire à une seconde ligne tangente au support au premier point.

17. Dispositif de balayage de film (100) selon la revendication 15, dans lequel une roue dentée (140) est disposée à une extrémité de l'un des rouleaux (120) et dans lequel le rouleau de masquage (130) comprend une pluralité de trous régulièrement espacés (142) le long d'un bord du ruban (130) passant au travers, les trous (142) pouvant entrer en contact avec la roue dentée (140) de sorte que, quand le rouleau tourne, la roue dentée (140) entre en contact avec les trous (142) amenant ainsi l'ouverture (132) à se déplacer d'une distance prédéterminée à chaque rotation du rouleau (120).

18. Dispositif de balayage de film (100) selon la revendication 15, dans lequel le côté avant du boîtier (110) est sensiblement courbe et le moyen pour porter une feuille de film radiologique (112) dans l'enceinte est sensiblement courbe.

19. Dispositif de balayage de film (100) selon la revendication 15, comprenant en outre un moyen pour guider le ruban de masquage (130) disposé dans l'enceinte de sorte que l'ouverture (132) est maintenue à une distance prédéterminée de la partie de la feuille de film (112) exposée quand l'ouverture (132) se déplace du premier rouleau (120) au second rouleau (120).

20. Dispositif de balayage de film (100) selon la revendication 15, dans lequel la partie radio-opaque (130) comprend un métal suffisamment dense pour bloquer le passage des rayons X.

21. Dispositif de balayage de film (100) selon la revendication 20, dans lequel le métal est de l'aluminium.

22. Dispositif de balayage de film (100) selon la revendication 20, dans lequel le métal est du cuivre.

23. Dispositif de balayage de film (100) selon la revendication 20, dans lequel le métal est du plomb.

24. Dispositif de balayage de film (100) selon la revendication 20, dans lequel le métal est un alliage.

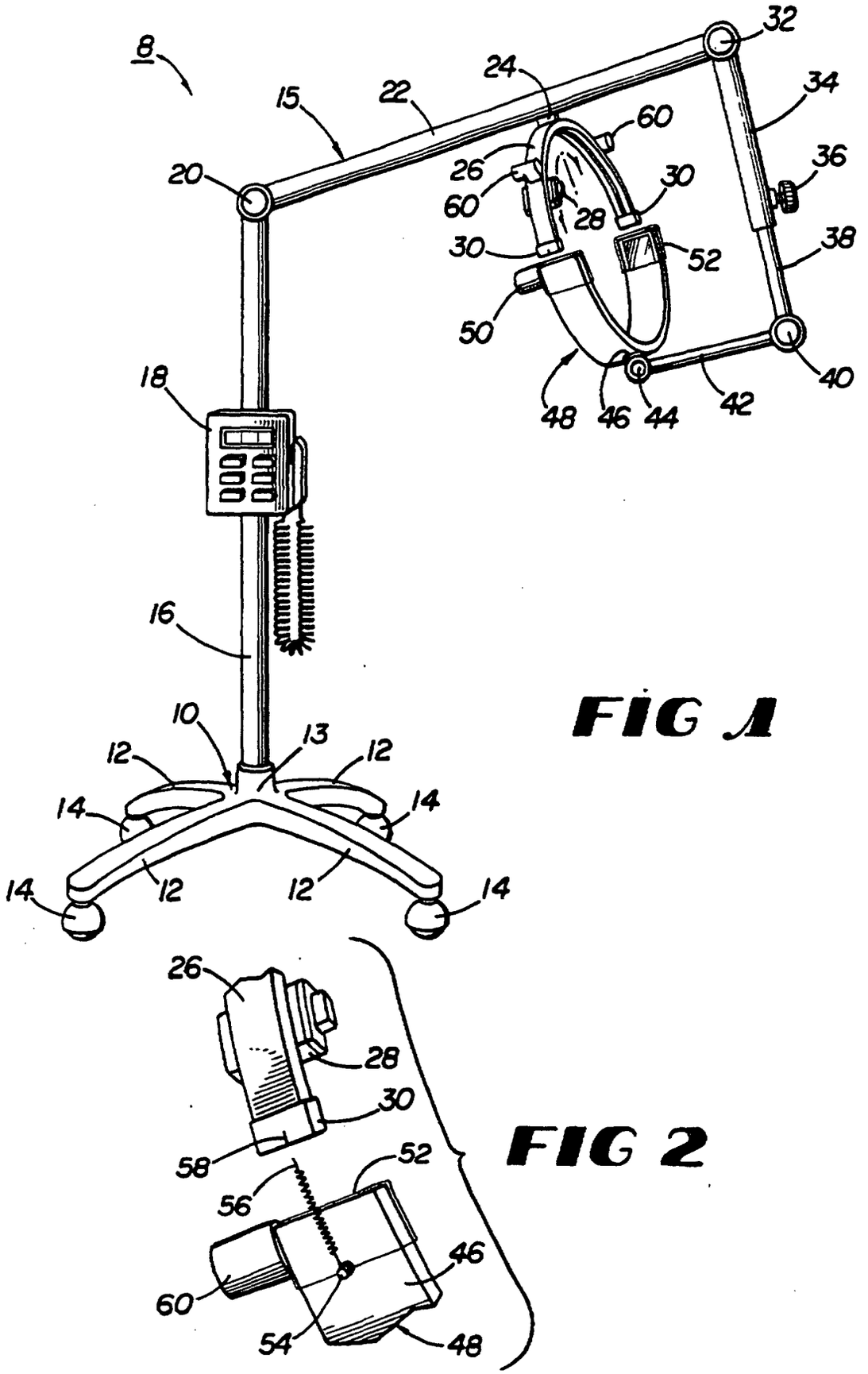
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FIG 1

FIG 2

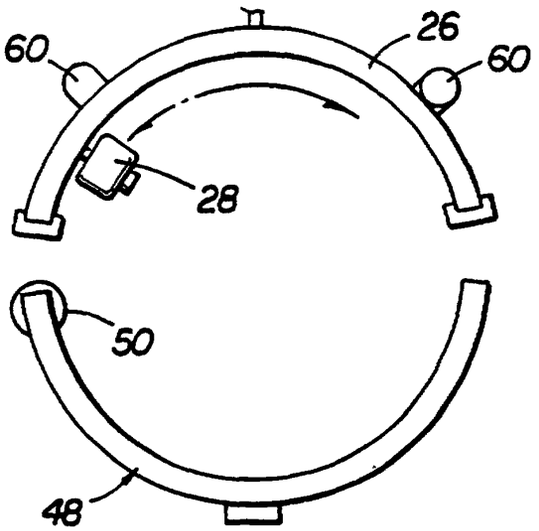

FIG 3A

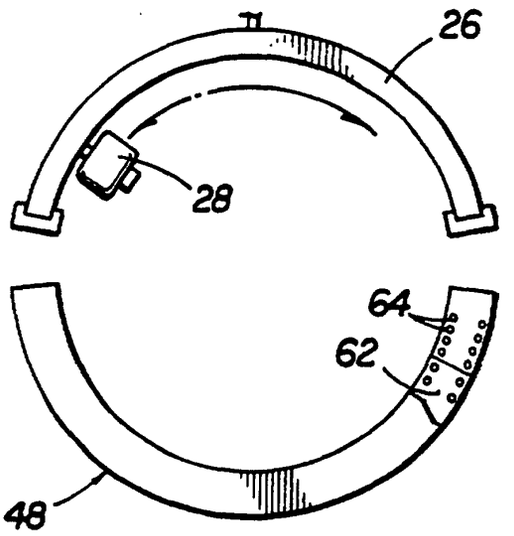

FIG 3B

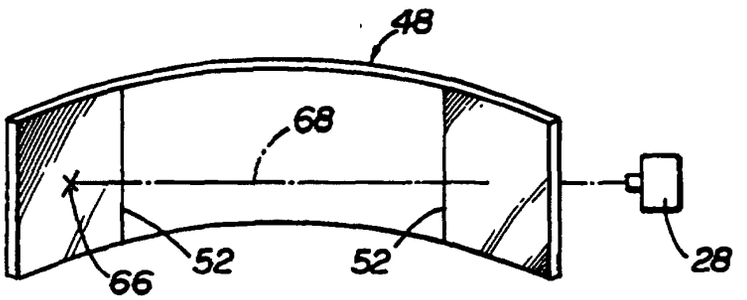

FIG 4

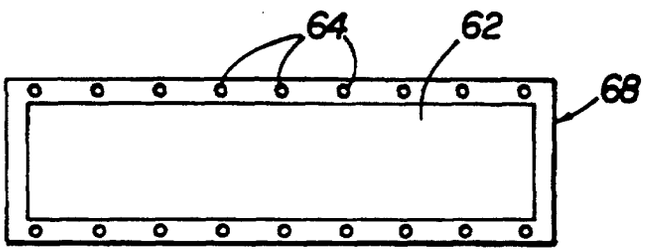

FIG 5

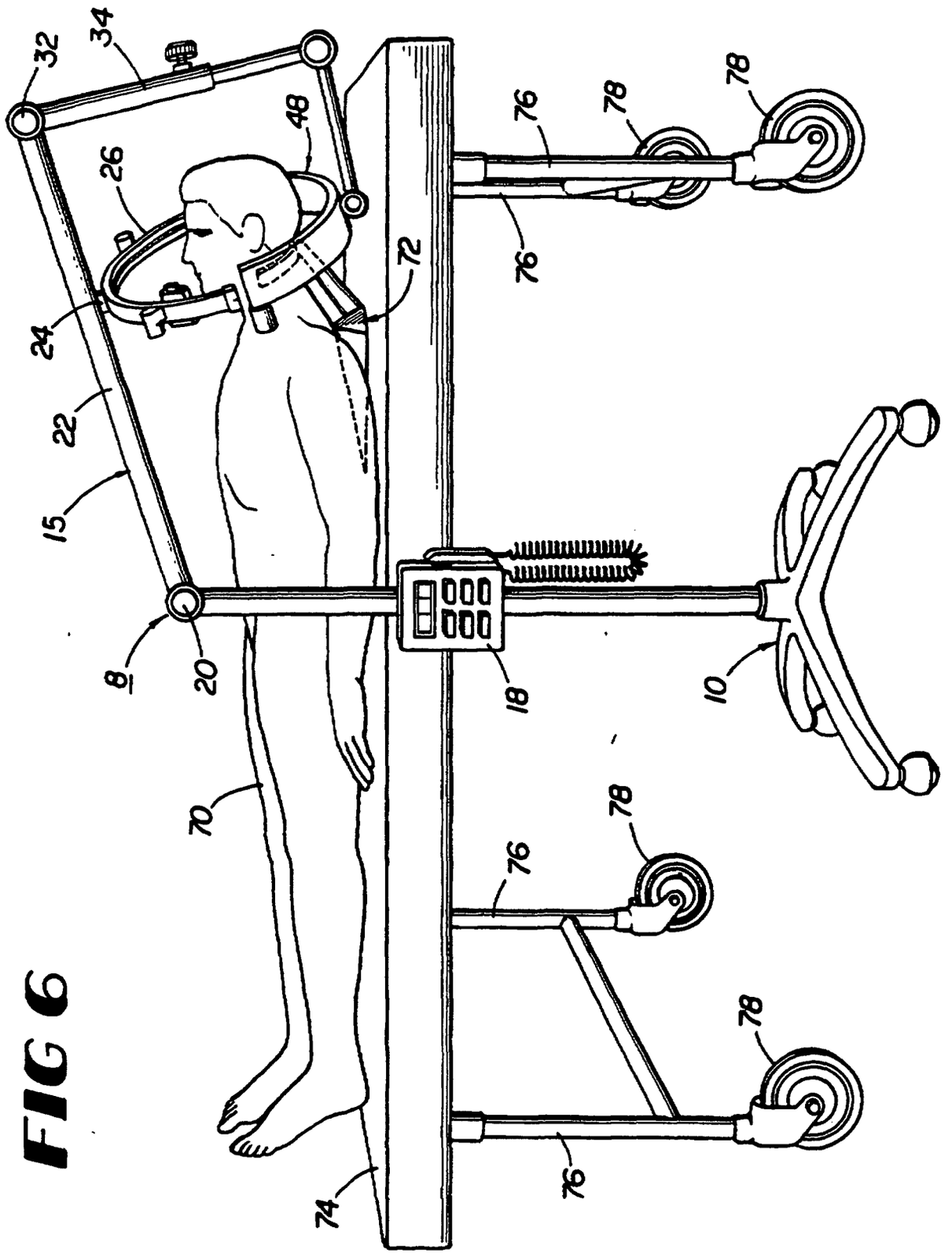

FIG 6

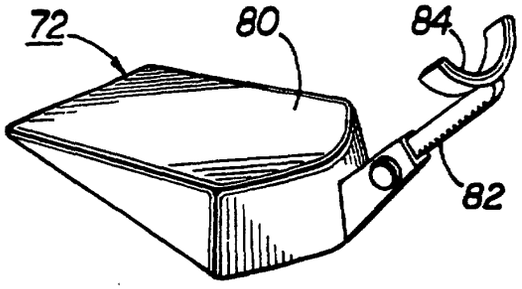

FIG 7

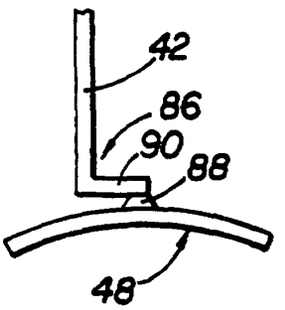

FIG 8

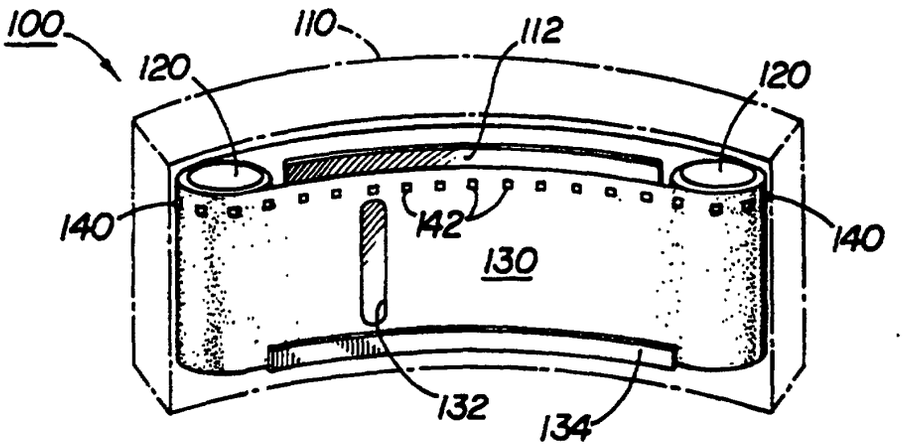

FIG 9A

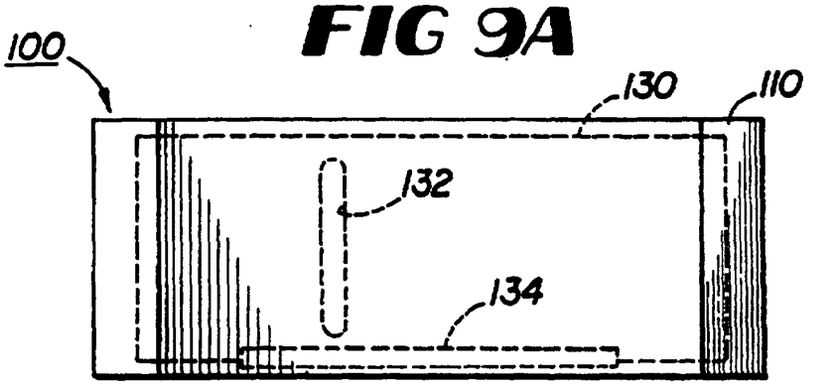

FIG 9B

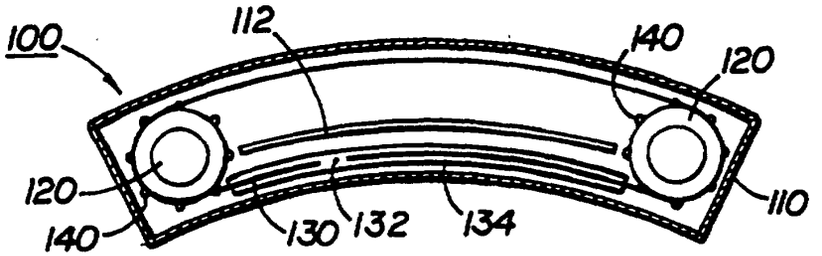

FIG 9C

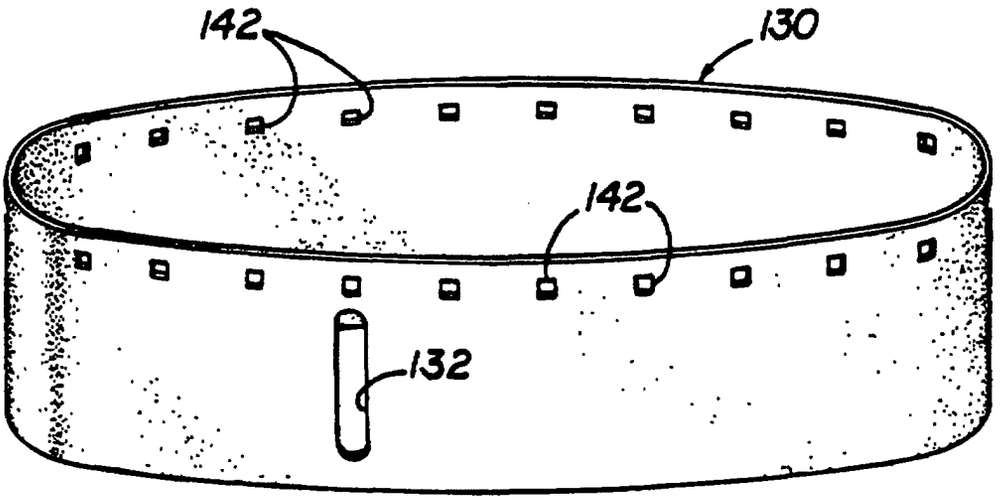

FIG 10

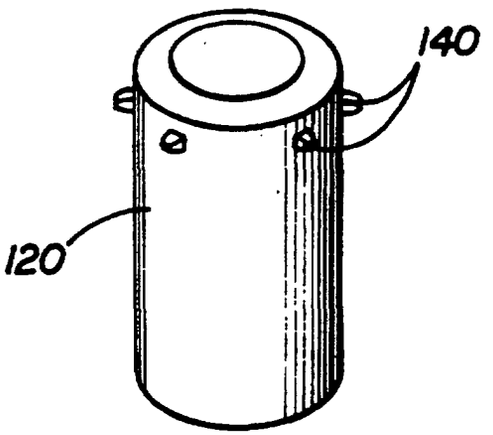

FIG 11